

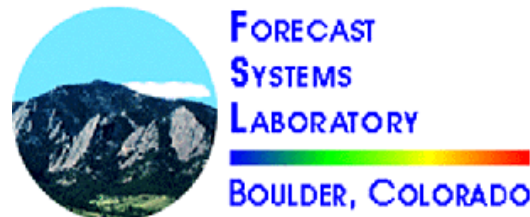
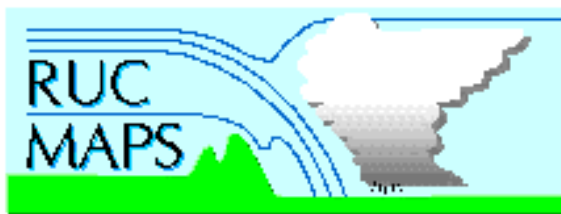
GLFE Real-Time TAMDAR Impact Experiments with the 20km RUC *September 2005 report*

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Tracy Lorraine Smith, Barry Schwartz,
Brian Jamison

(NOAA Forecast Systems Laboratory)

NOAA / ESRL / GSD ← New Name!

Boulder, CO



Outline of Talk

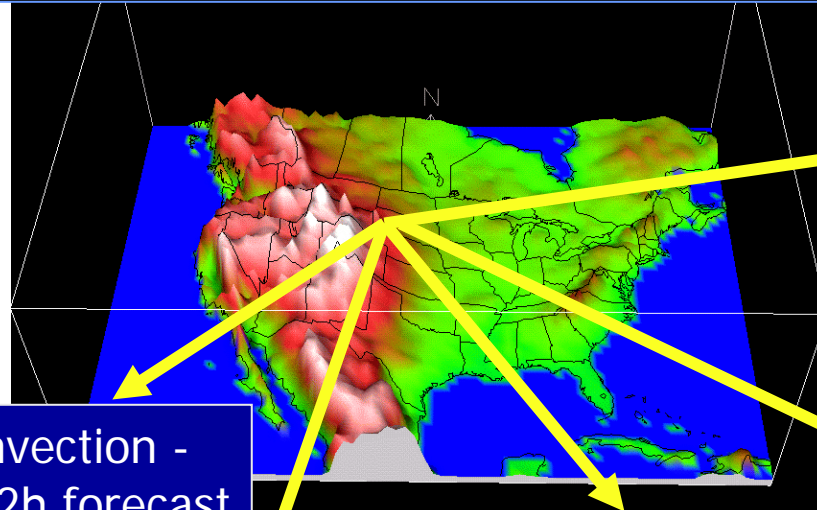
- **General description of RUC 1h cycle**
- **TAMDAR error characteristics as revealed by the RUC**
- **Description of RUC parallel experiments**
 - “dev” without TAMDAR
 - “dev2” with TAMDAR
- **Skill results**

Purpose for Rapid Update Cycle (RUC) model run operationally at NCEP

- Provide high-frequency mesoscale analyses, short-range model forecasts
- **Use all available observations**
- Users:
 - aviation/transportation
 - severe weather forecasting
 - general public forecasting
- Focus on 1-12 hour forecast range

Aviation Forecast Guidance from the Rapid Update Cycle (RUC)

20 km grid resolution x 50 vertical levels x 14 variables



Convection -
2-12h forecast

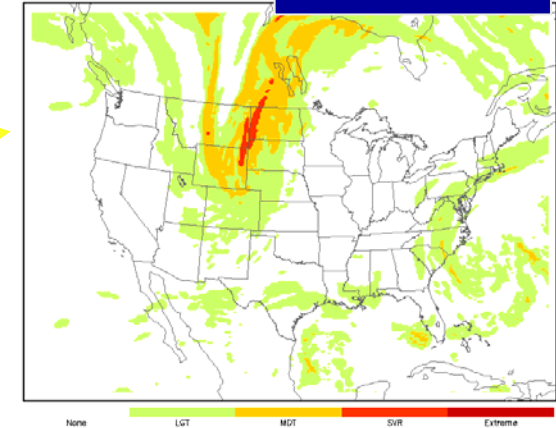
Ceiling/visibility

Terminal / surface

RUC information / products -
<http://ruc.fsl.noaa.gov>

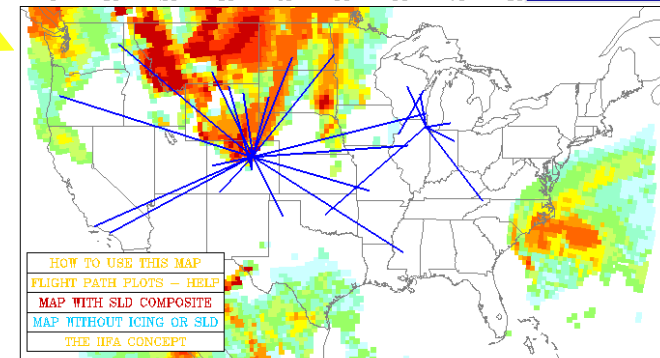
Turbulence forecast at FL270
12 hr

Turbulence



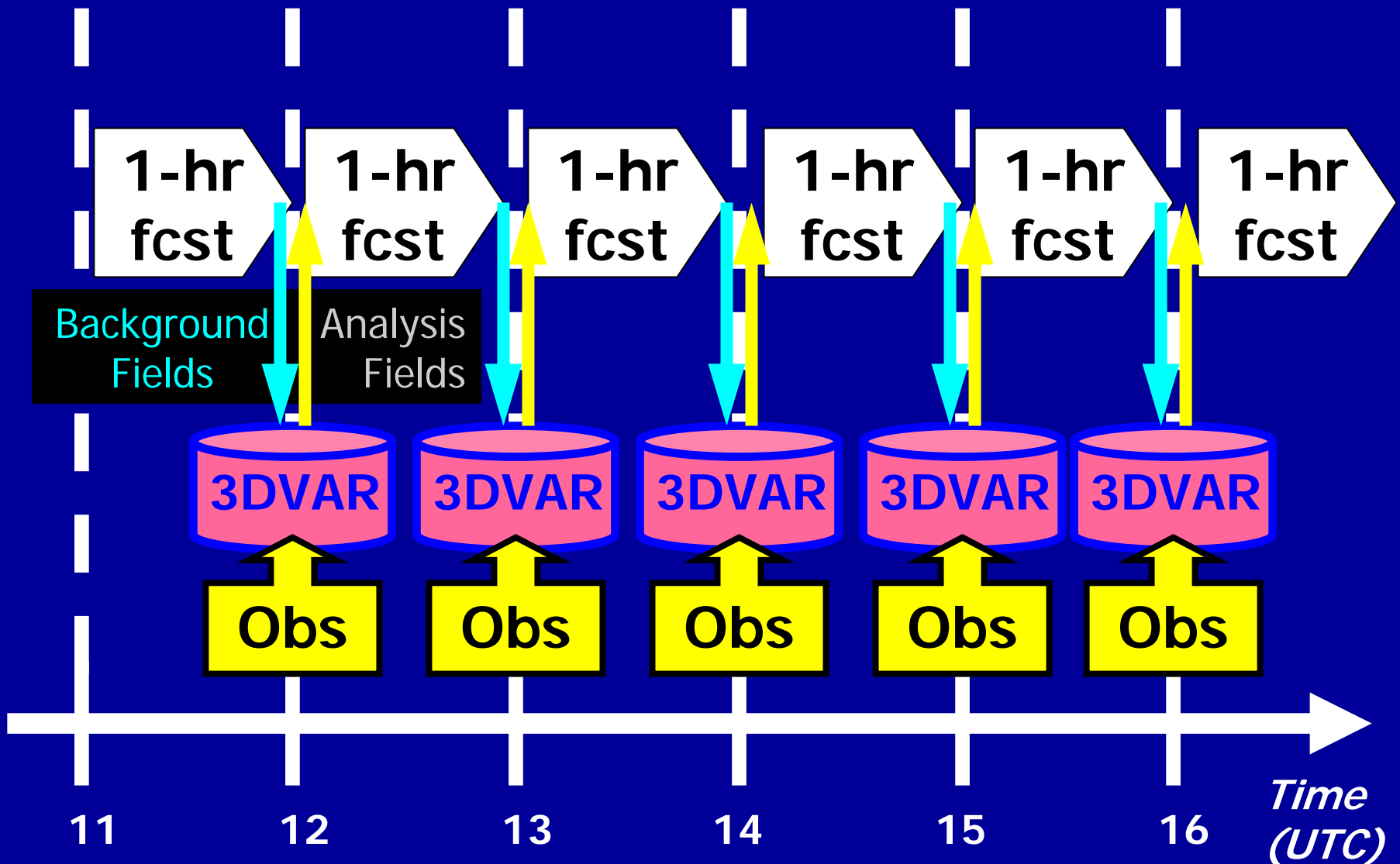
IIFA 09 HR FORECAST VALID AT 09/18/2003 -
ICING COMPOSITE - CHOOSE A CROSS SECTION OR OT

Icing

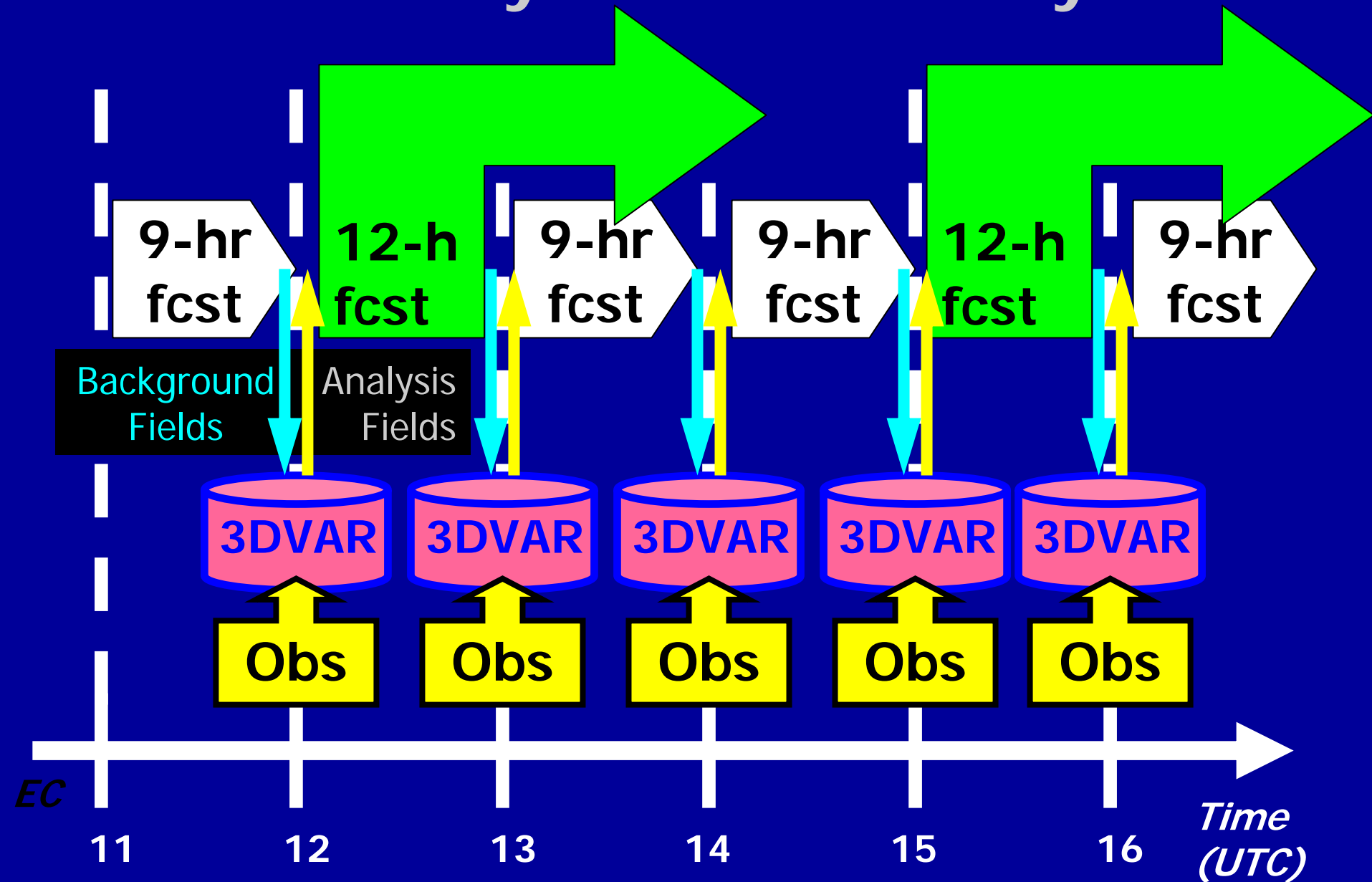


*Better weather products require improved high-frequency
high-resolution models with high-refresh data to feed them*

RUC Hourly Assimilation Cycle



RUC Hourly Assimilation Cycle

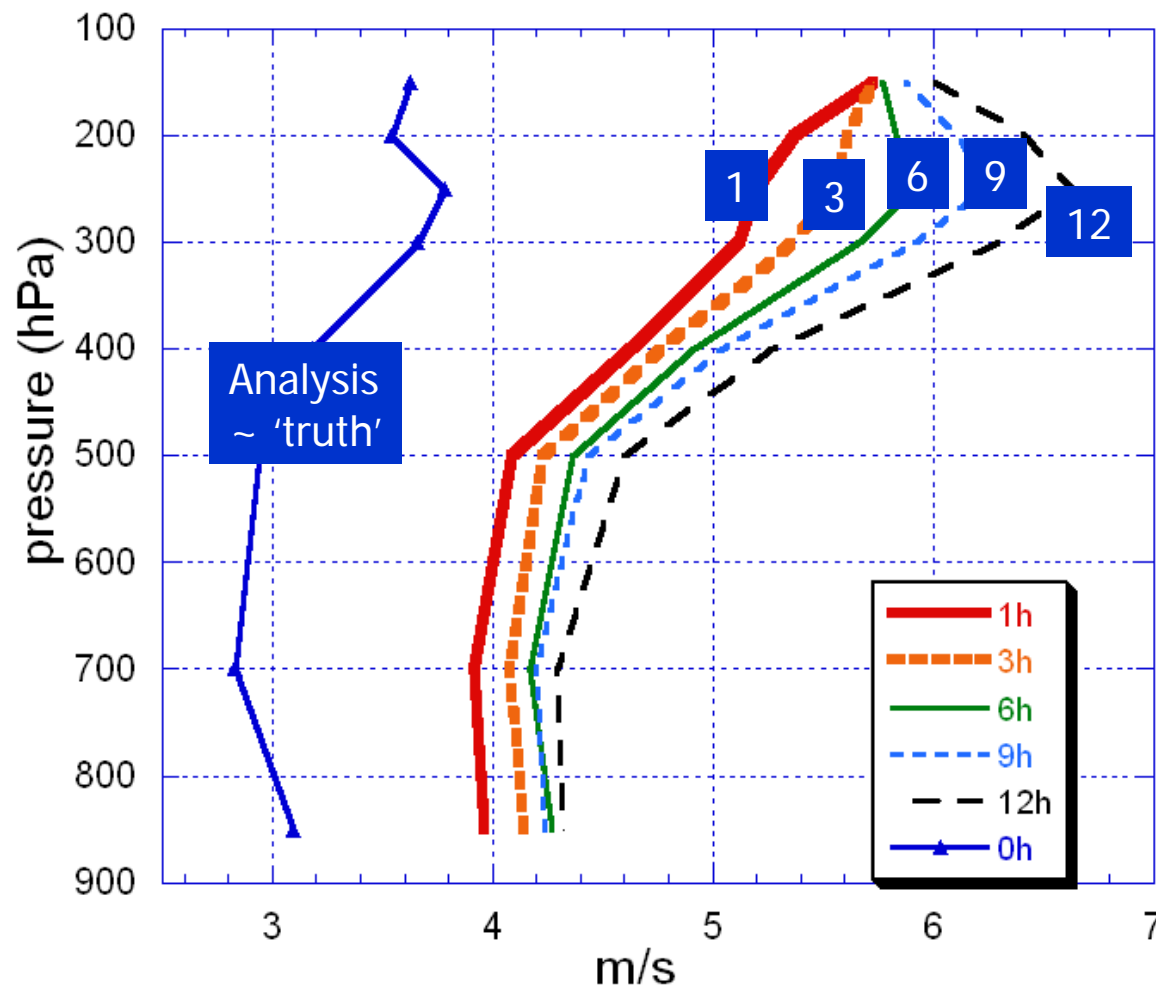


Observations used in RUC

Data Type	~ Number	Freq.
Rawinsonde	80	/12h
NOAA profilers	30	/ 1h
VAD winds	110-130	/ 1h
Aircraft (V,temp)	1400-4500	/ 1h
Surface/METAR	1500-1700	/ 1h
Buoy/ship	100-150	/ 1h
GOES precip water	1500-3000	/ 1h
GOES cloud winds	1000-2500	/ 1h
GOES cloud-top pres	~10km res	/ 1h
SSM/I precip water	1000-4000	/ 6h
GPS precip water	~300	/ 1h
Mesonet	~5000	/ 1h
PBL – prof/RASS	~20	/ 1h
Radar refl / lightning	4 km res	

NCEP
operational

FSL
experimental



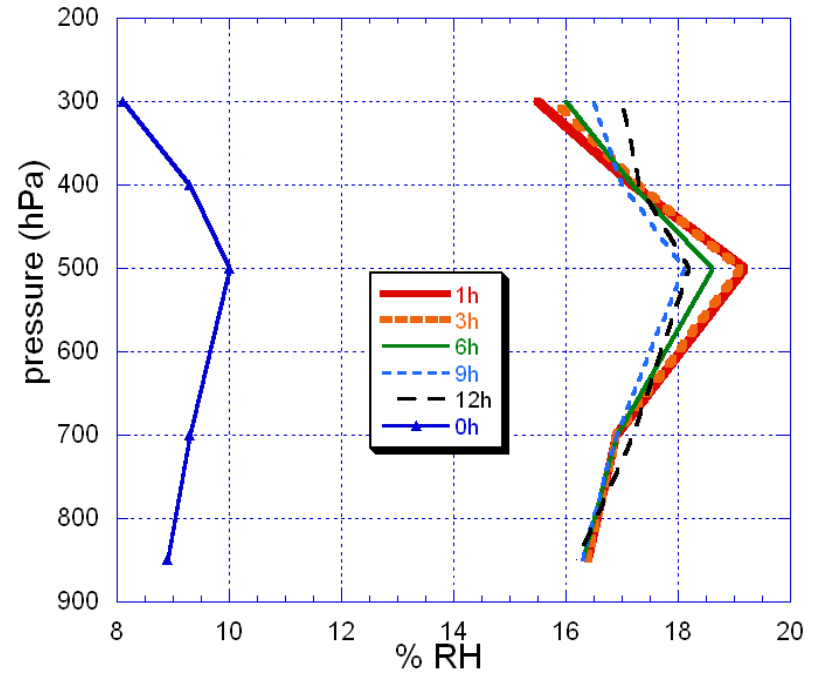
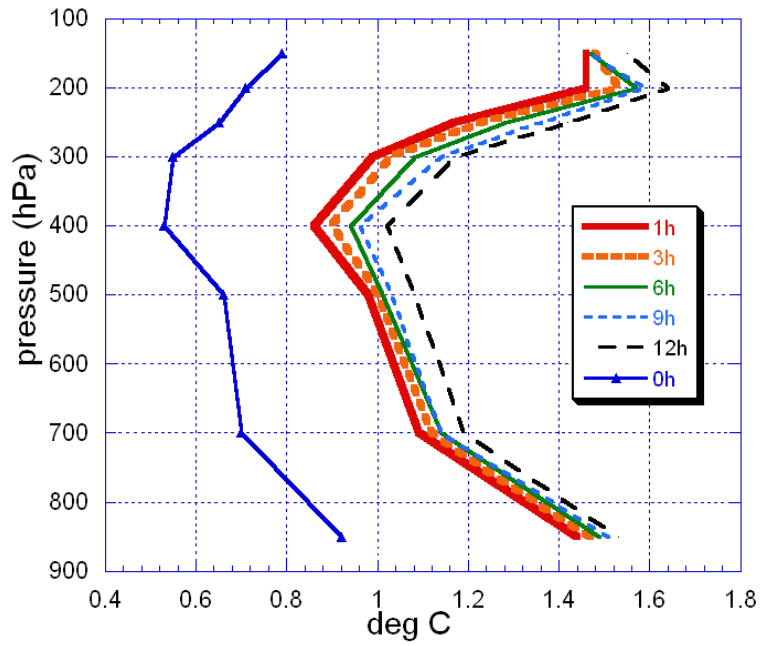
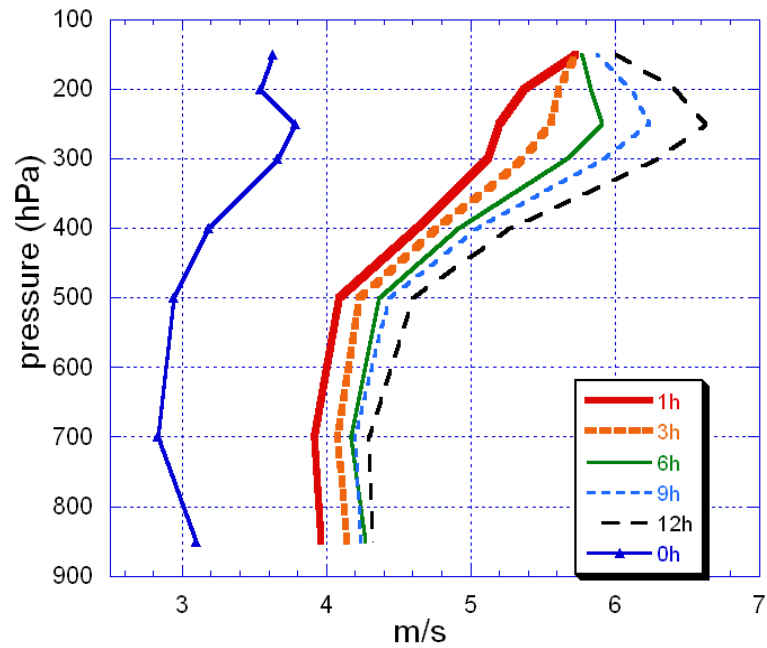
RUC
Wind forecast
Accuracy

-Sept-Dec
2002

Verification against rawinsonde data over RUC domain
RMS vector difference (forecast vs. obs)

RUC is able to use recent obs to improve forecast skill
down to 1-h projection for winds

Results from Fall 2002

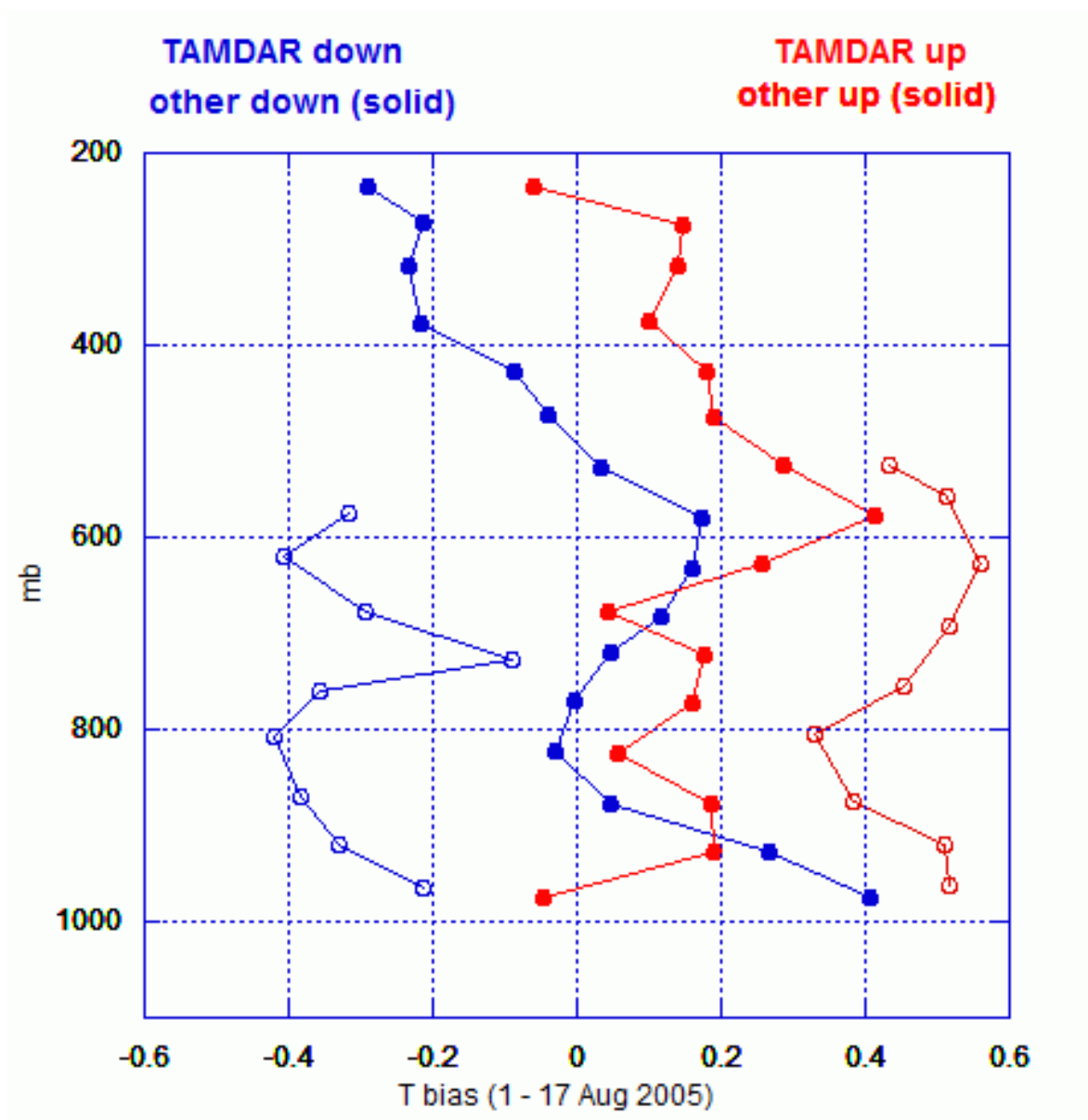


We use the RUC to investigate TAMDAR Error Characteristics

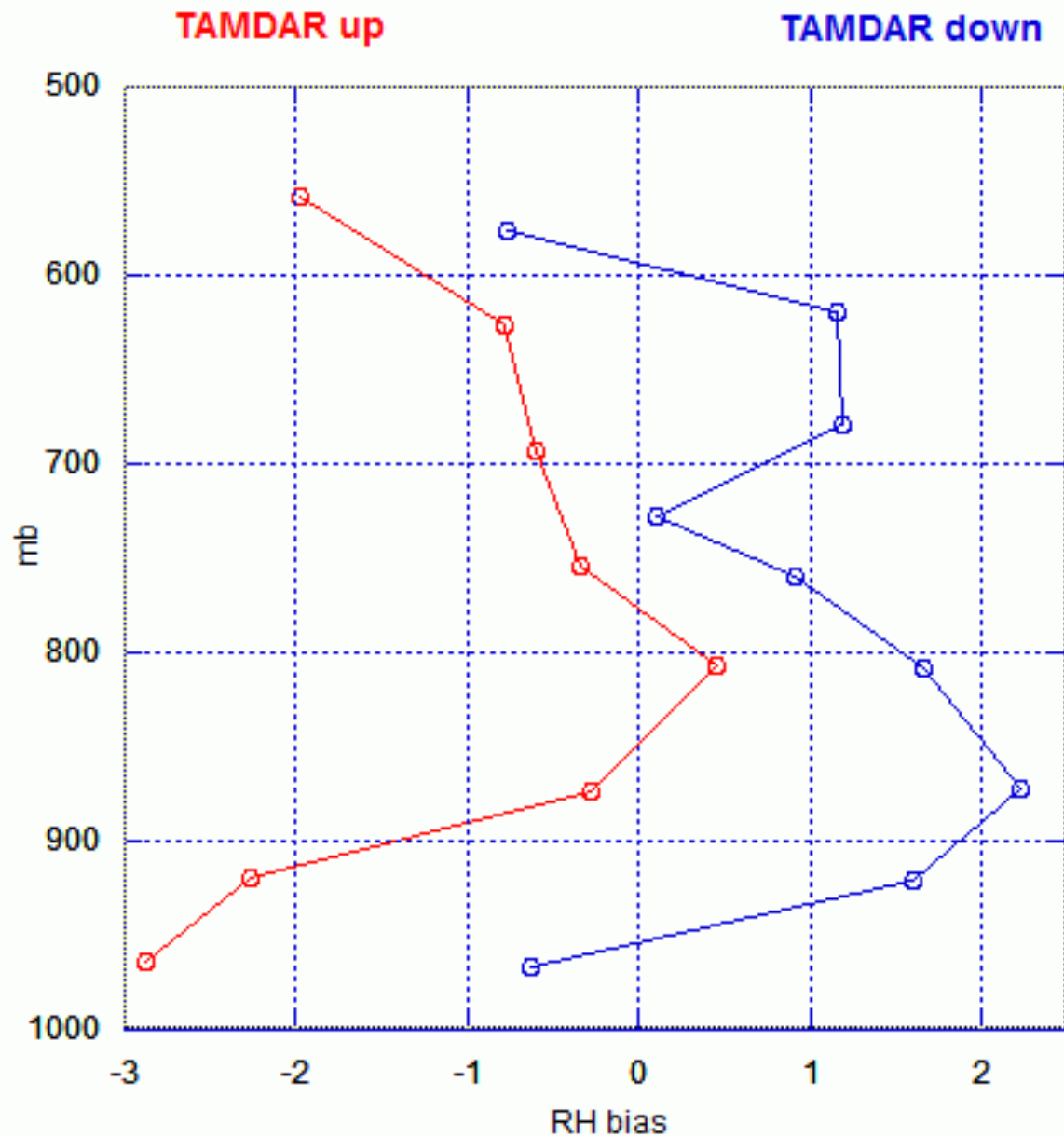
Most of the following plots show:

- **Data from 1 - 17 Aug 2005**
- **Differences between ob and dev2 RUC**
 - (ob minus model)
 - for data passing RUC QC (and not on reject list)
 - (we reject about 2% of TAMDAR Temperature obs)
 - (we reject about 10% of TAMDAR Wind and RH obs)
- **To facilitate comparison with other airlines:**
 - No data between 0300 and 1200 UTC
 - Only data in the TAMDAR region
 - lat between 37°N and 49°N
 - lon between 75°W and 101°W
- **“Other” is all airlines except**
 - TAMDAR and CN-D8

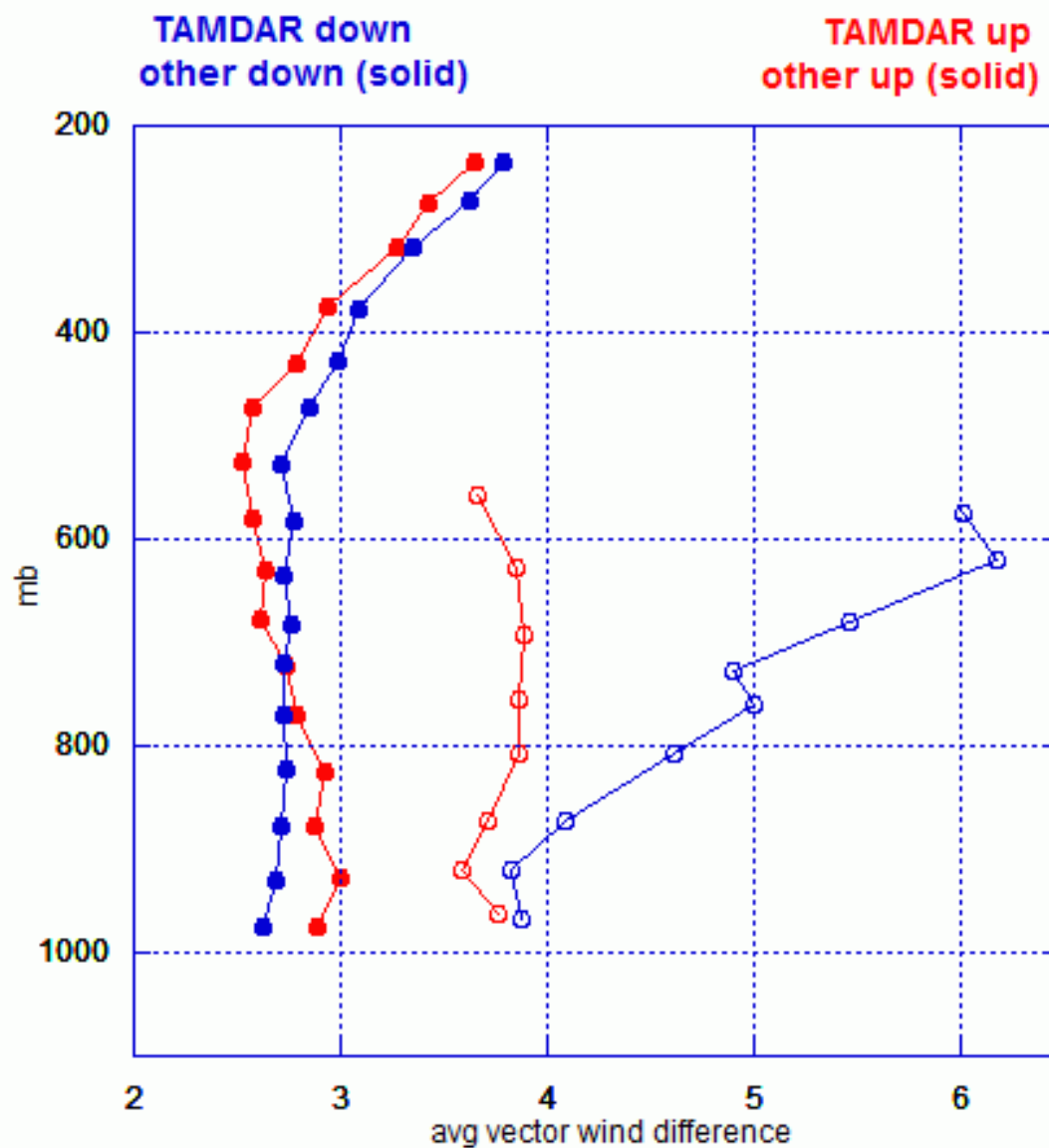
Temperature



TAMDAR Relative Humidity Bias Reflects T bias



Vector obs-RUC Wind difference (m/s)



Summary of TAMDAR Error Characteristics

- **TAMDAR Temperatures are generally good**
 - however, ascents have a warm bias, descents have a cool bias
- **TAMDAR RH errors**
 - reflect the temperature bias
- **TAMDAR winds are more troublesome**
 - substantial errors on descent, possibly due to maneuvers
 - errors on ascent are greater than other fleets

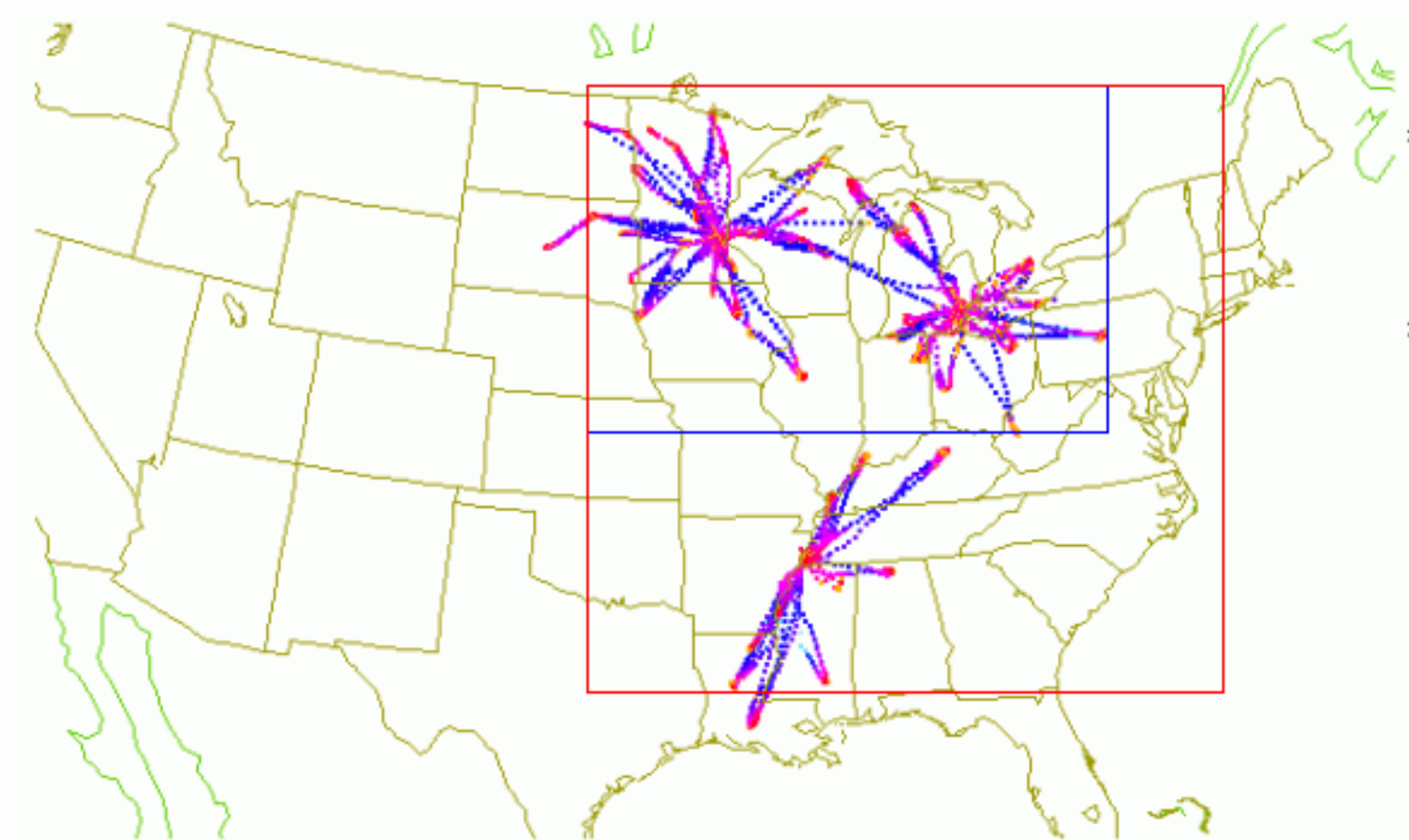
Real-time TAMDAR RUC impact experiment design

- **Parallel 20km RUC 1-h cycles run in real time**
 - “dev” cycle – no TAMDAR
 - “dev2” cycle – dev + TAMDAR data
 - Lateral boundary conditions – same for dev and dev2
- **Ensure runs are “parallel”**
 - Initialize dev and dev2 runs at exact same time
 - Reset dev and dev2 background fields every 49 h
- **The following skill results show differences in dev and dev2 skill**
 - each verified against RAOBS

Verification regions for FSL-RUC TAMDAR impact

Large region (eastern half of US) -- 38 RAOB sites

Small region (Great Lakes) includes 14 RAOBs



TAMDAR evaluation phases

Phase 1 – 9 Feb – 21 April 2005

- Winter/early spring – lower vertical resolution

Phase 2 – 22 April – 1 June

- Spring – higher vertical resolution

Phase 3 – 2 June – 22 July

- Summer – higher vertical resolution

Phase 4 – 23 July – 24 August

- Summer – lower vertical resolution

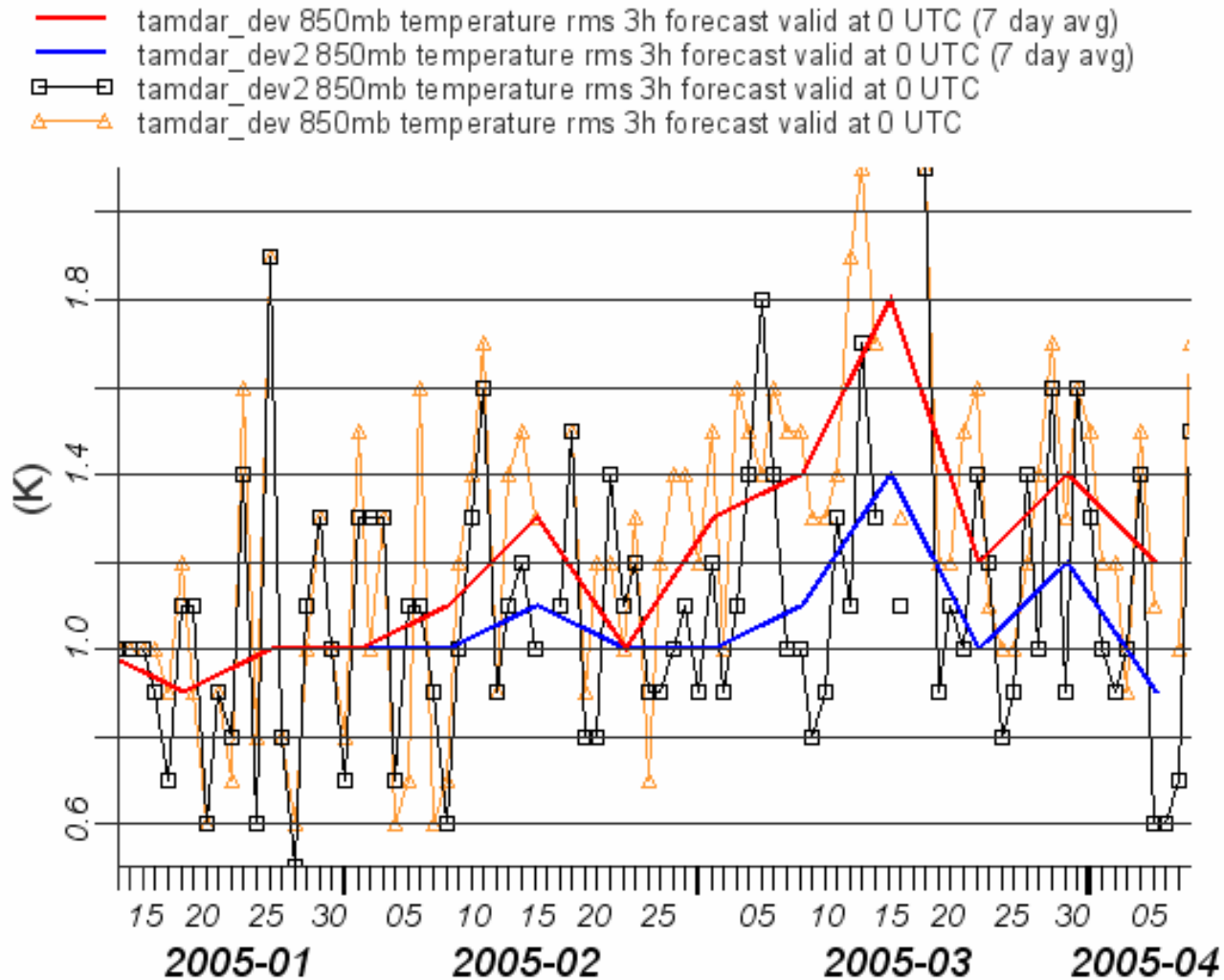
TAMDAR evaluation w/ RUC parallel cycles

- **Summary evaluation over each of 4 phases**
- **Screened out any dates with questionable results**
 - If logs showed missing 1h RUC runs for either dev or dev2 cycles
 - If dev/dev2 verification stat differences over full national domain for winds > 0.2 m/s averaged over 8 mandatory levels
- **Results only shown for 00z verification, Gt. Lakes region.**
 - Less impact for 12z verif and/or E.US region

FSL-RUC TAMDAR impact experiment considerations

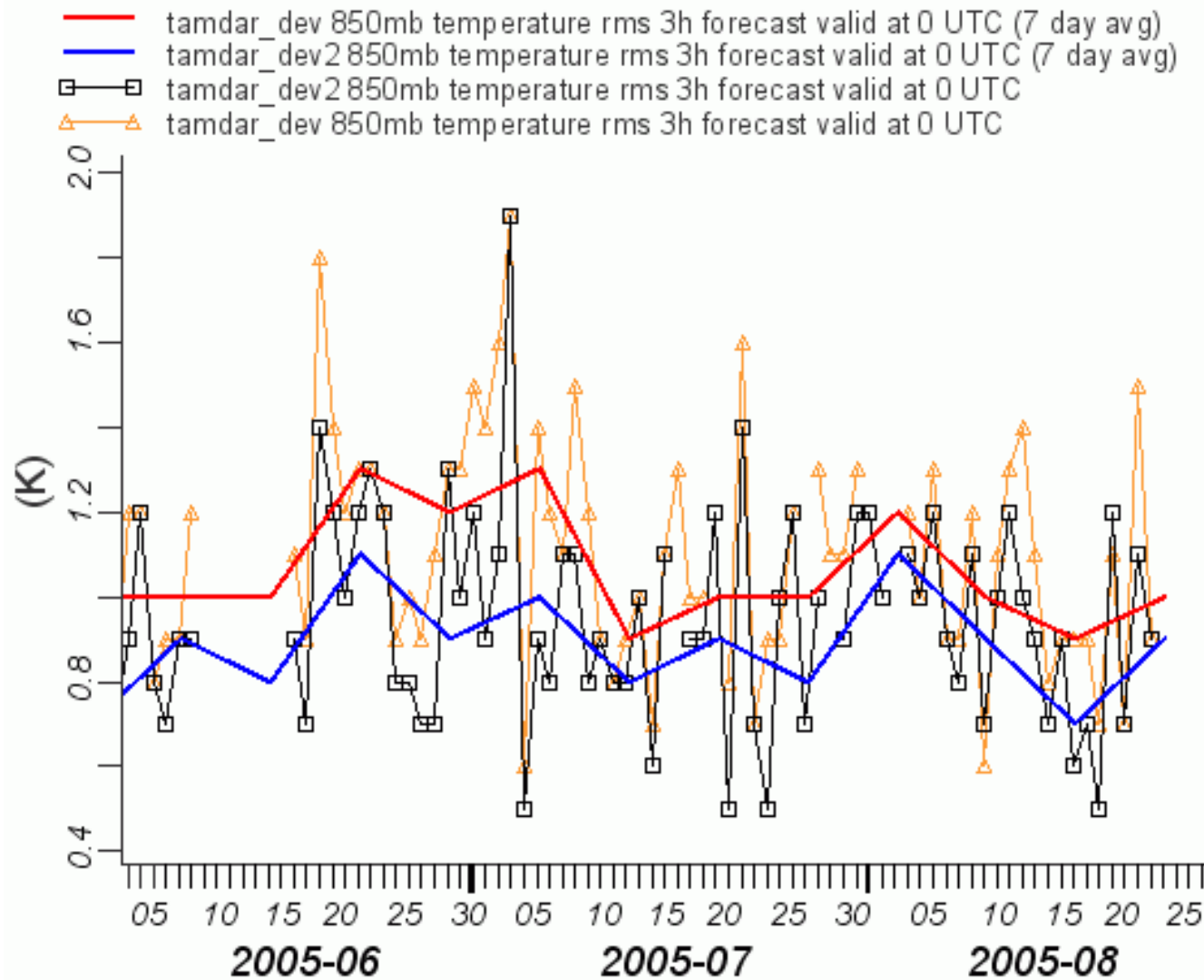
- Impact experiments must be conducted such as to show **value added to other existing observations**
 - RUC well-suited for this because it includes a large set of available observations
- The Real-time parallel cycles at FSL (dev/dev2) provide well-controlled experiments and results
 - Accelerated evaluation process

850 mb temp - clear improvement in the small (Gt. Lakes) region (in April)



Phase 1 – Jan-Apr 05

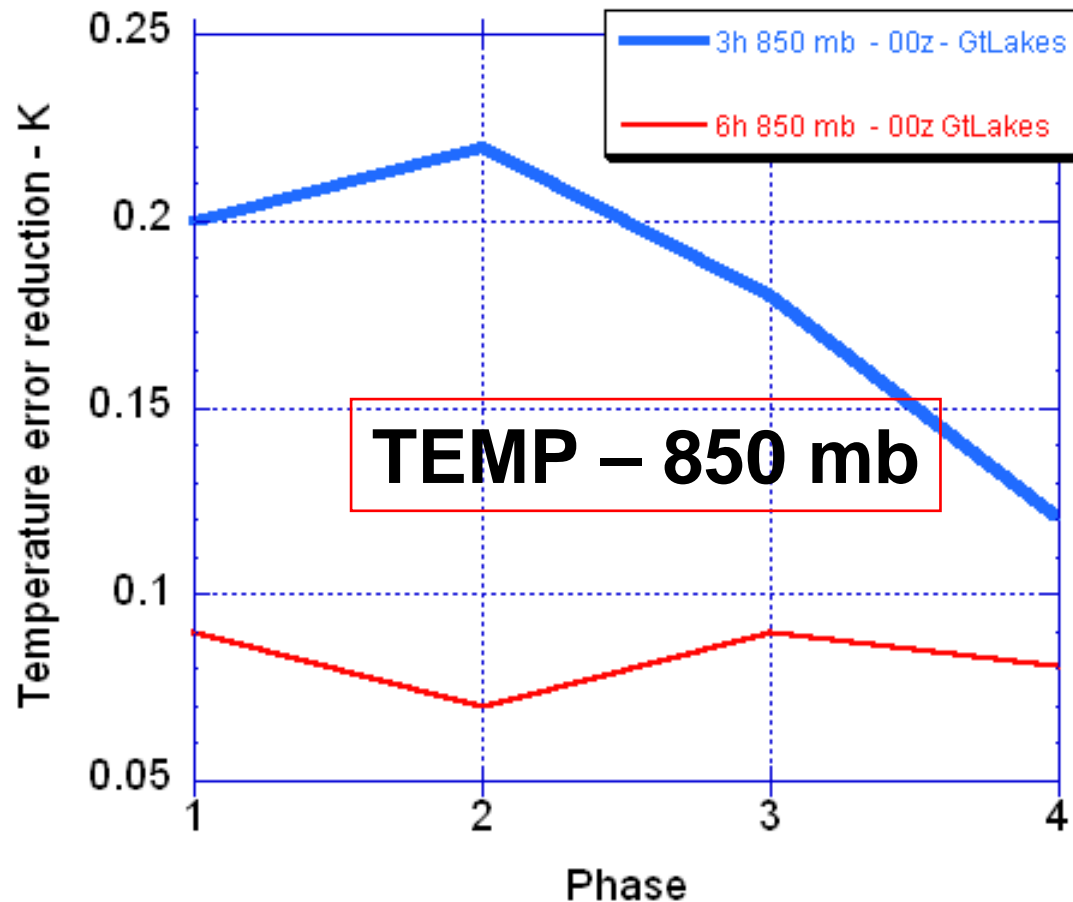
Temperature improvement continues in Phase 3-4



Phase 3-4 – Jun-Aug 05

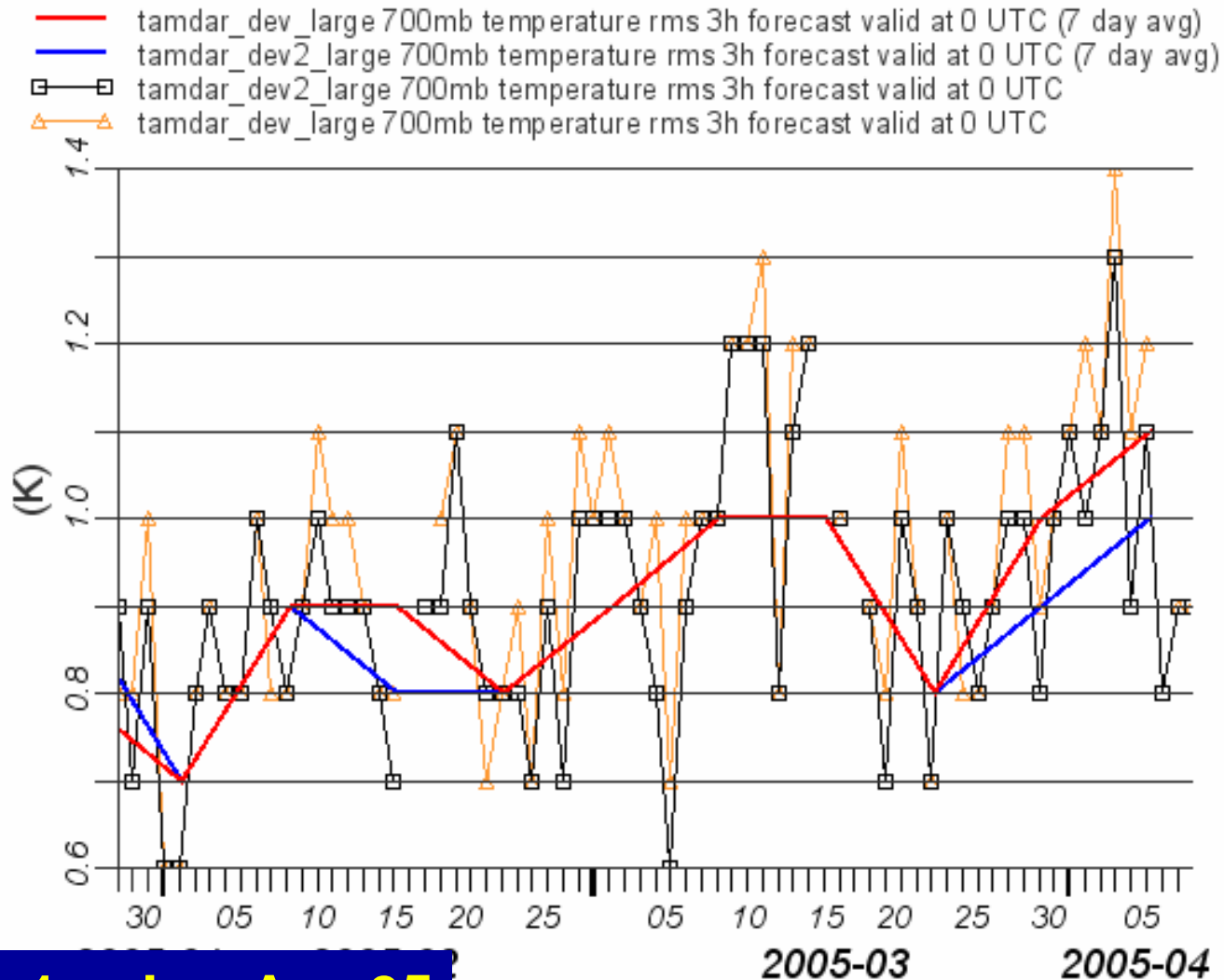
Temperature error summary

Positive → positive impact from TAMDAR data
(decrease in Phase 3-4 likely due to climatology)



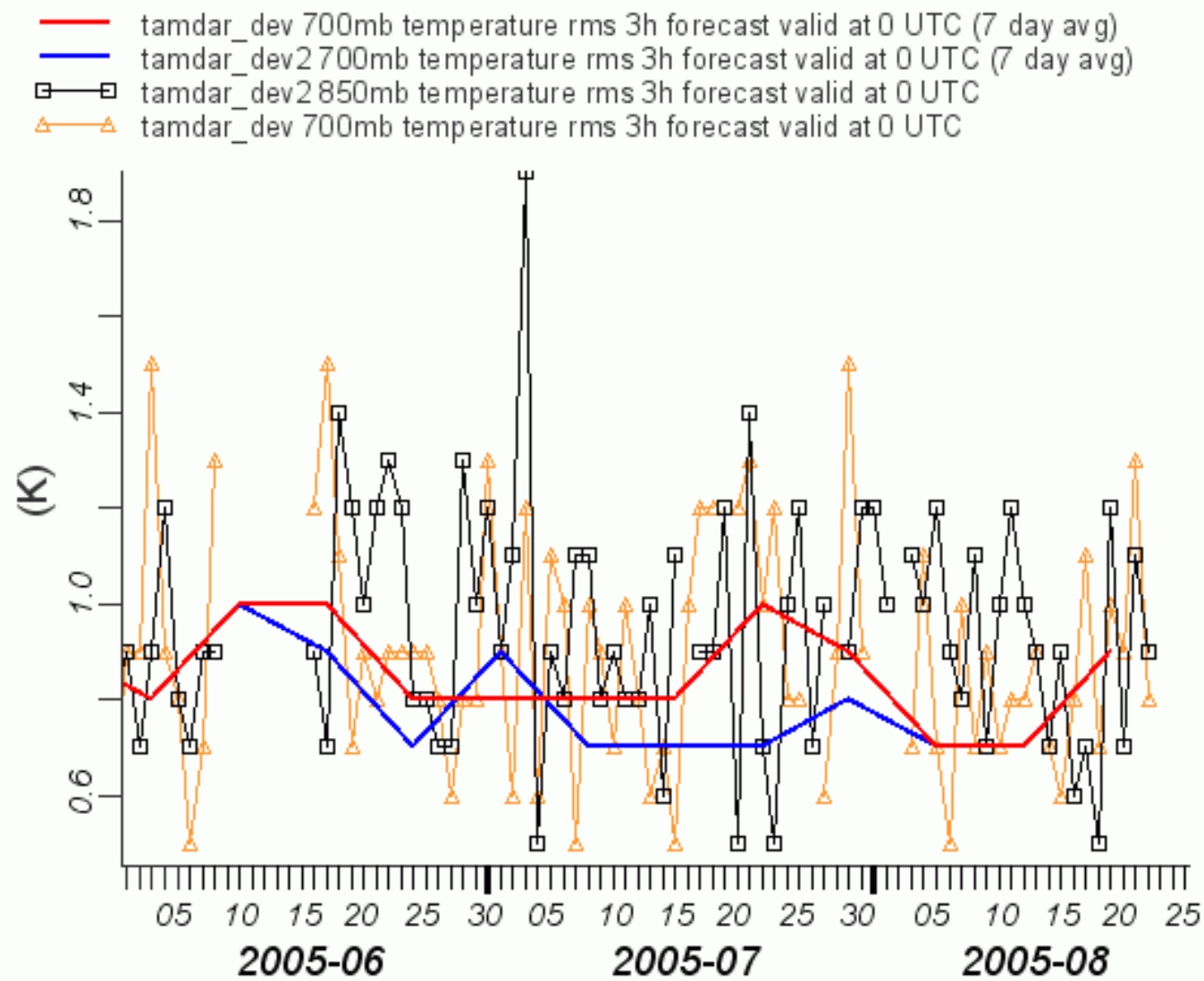
-- 30%
Reduction of
3h 850 mb
Temp.
fcst err

Temperature: some improvement for 700 mb, 3-h forecast (in April)



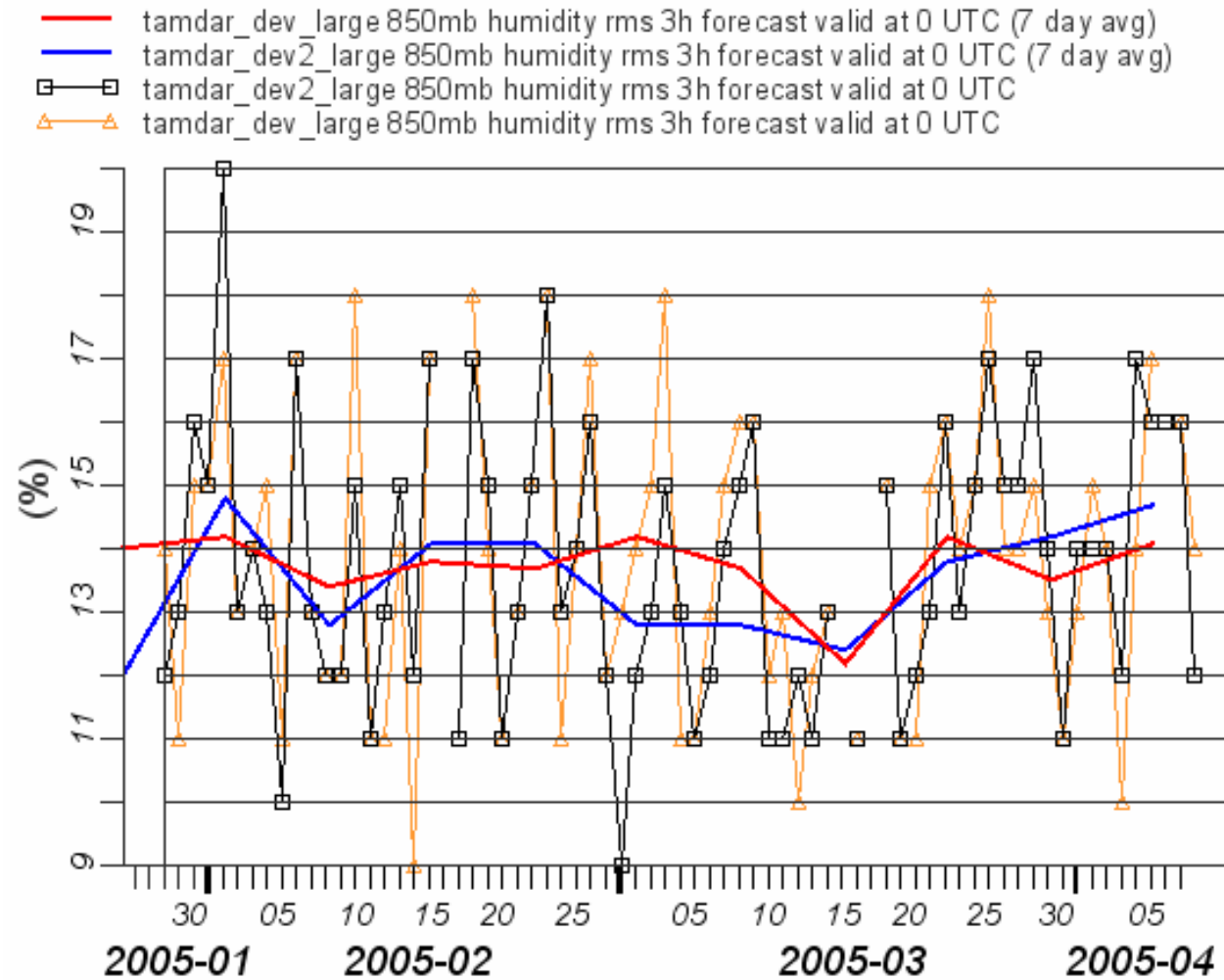
Phase 1 – Jan-Apr 05

TEMP – 700 mb (More improvement in Phase 3-4)

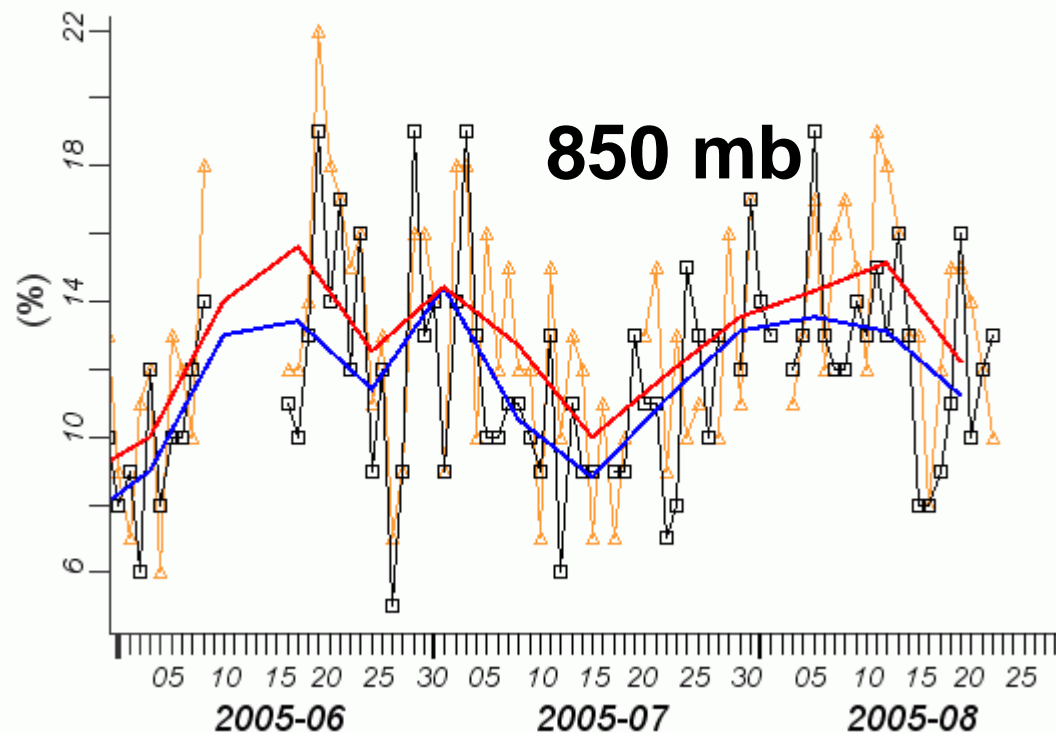


Phase 3-4 – Jun-Aug 05

Relative Humidity: not much difference (in April)



- tamdar_dev 850mb humidity rms 3h forecast valid at 0 UTC (7 day avg)
- tamdar_dev2 850mb humidity rms 3h forecast valid at 0 UTC (7 day avg)
- tamdar_dev2 850mb humidity rms 3h forecast valid at 0 UTC
- tamdar_dev 850mb humidity rms 3h forecast valid at 0 UTC

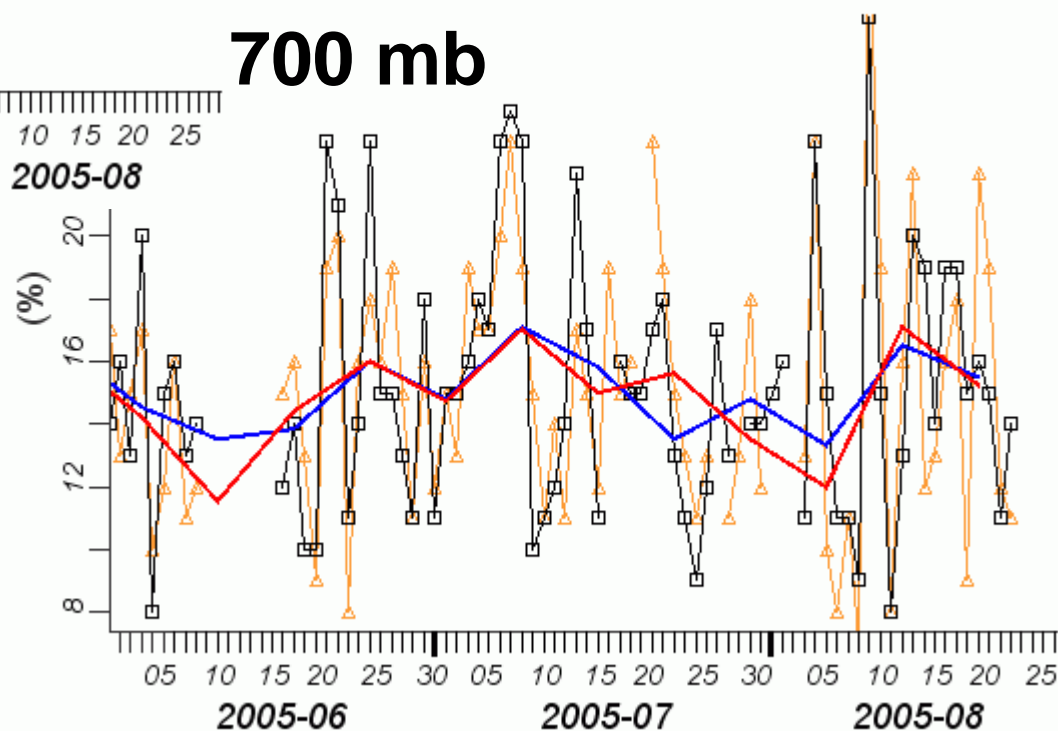


Humidity:
improvement at
850 mb, but not at
700 mb

in Phase 3-4

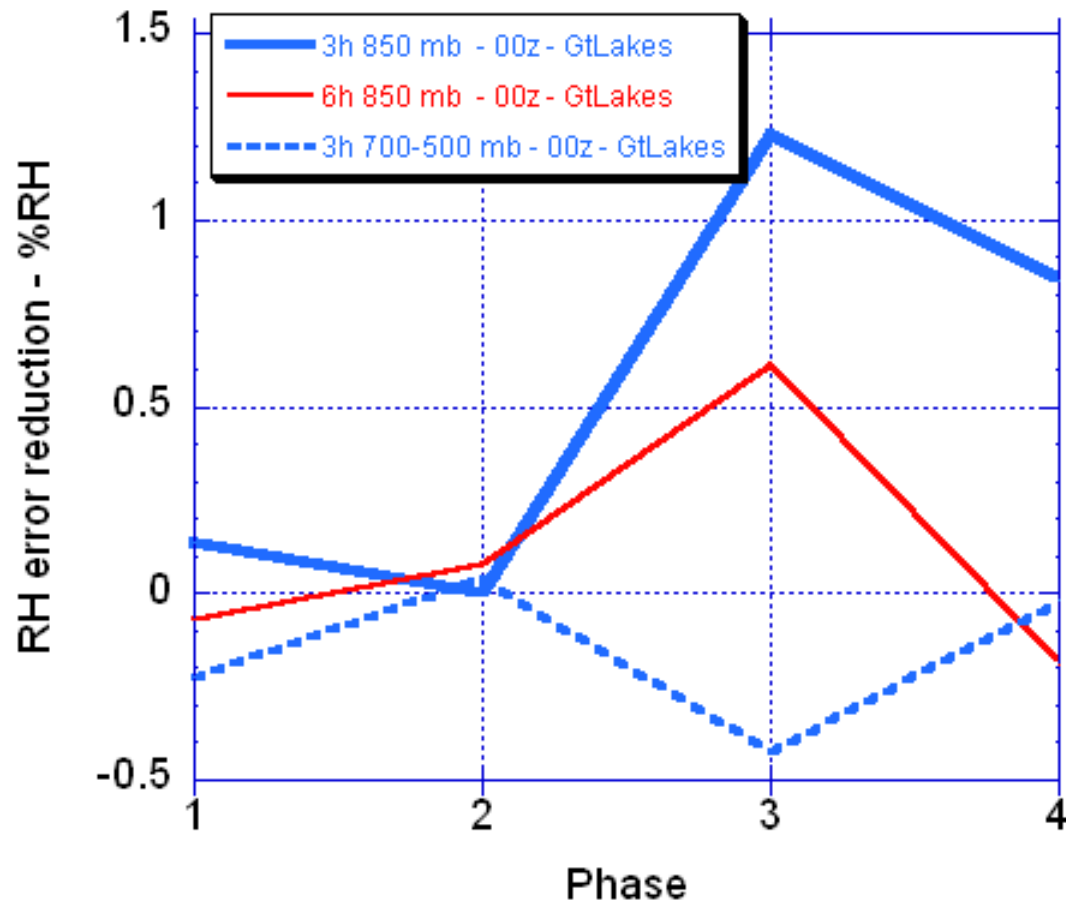
- w 700mb humidity rms 3h forecast valid at 0 UTC (7 day avg)
- w2 700mb humidity rms 3h forecast valid at 0 UTC (7 day avg)
- w2 700mb humidity rms 3h forecast valid at 0 UTC
- w 700mb humidity rms 3h forecast valid at 0 UTC

700 mb



Phase 3-4 – Jun-Aug 05

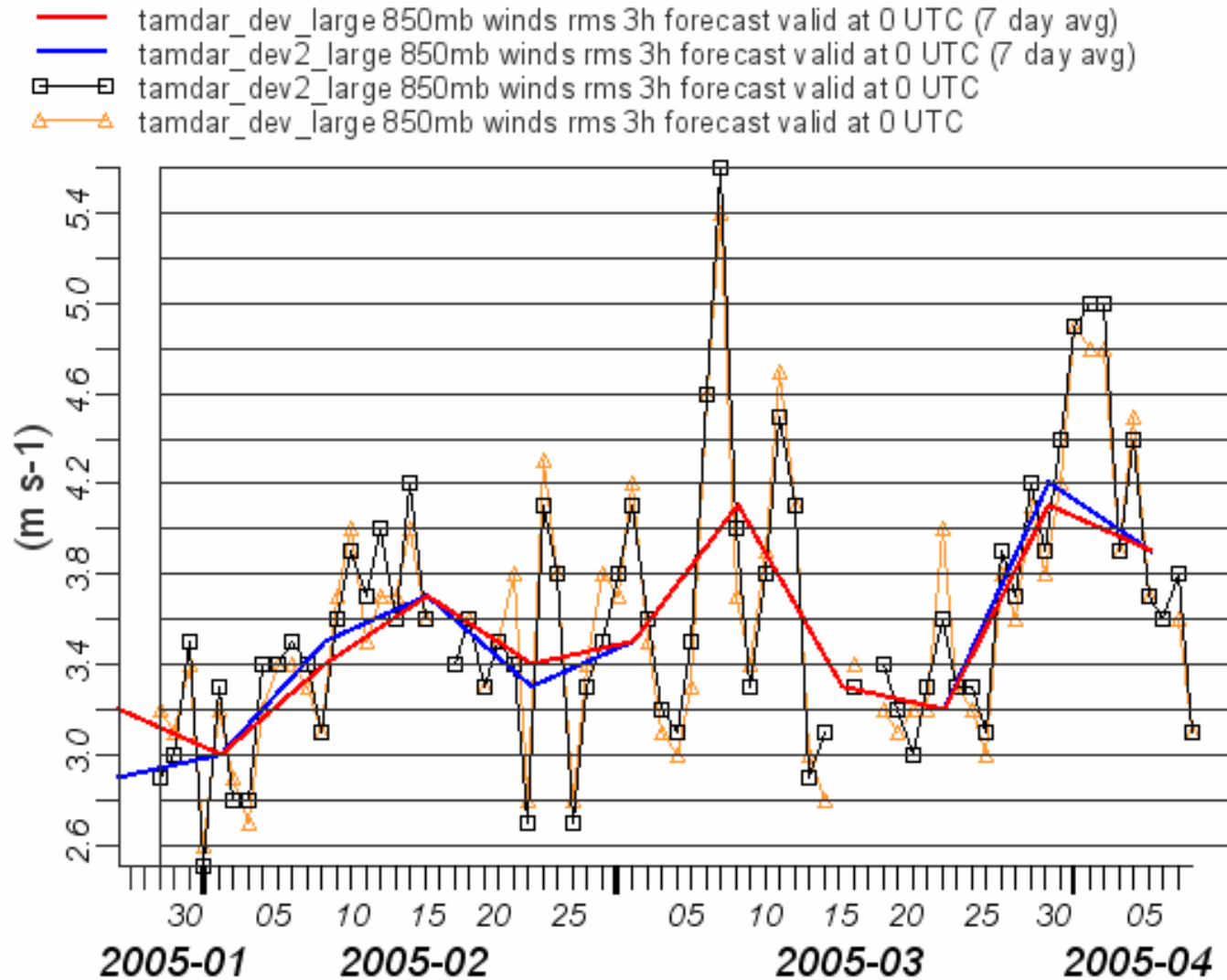
RH



-- Now: 12%
Reduction of
3h fcst err at
850 mb

(Negative impact
at 700 - 500 mb is
being
investigated)

Winds: not much difference (in April)

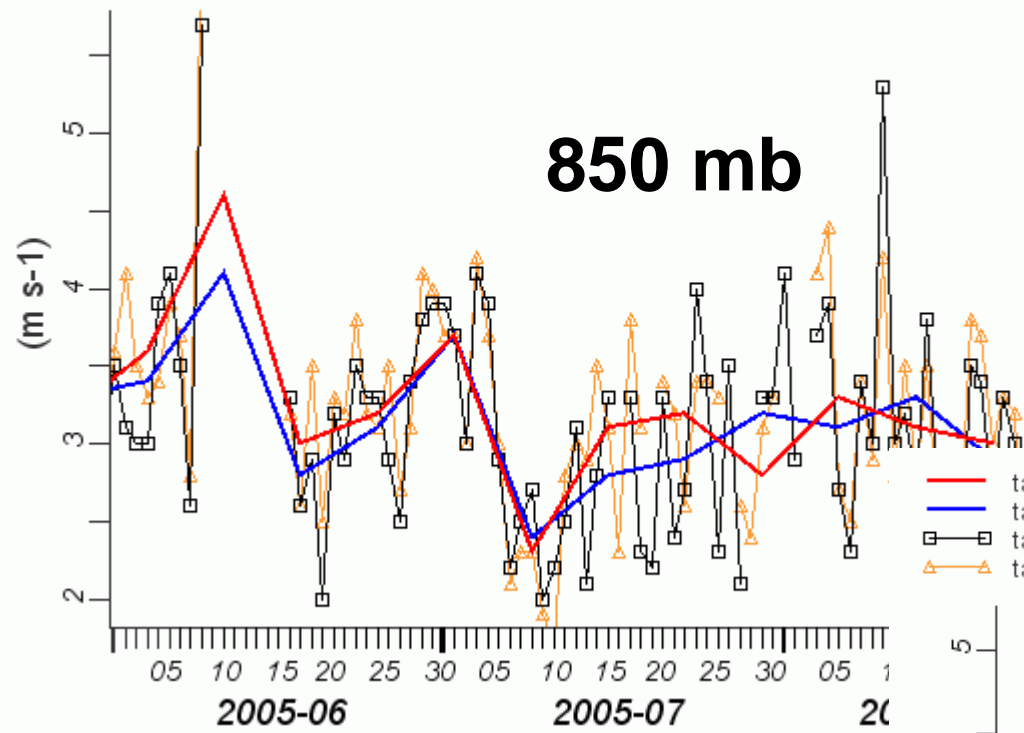


Phase 1 – Jan-Apr 05

- tamdar_dev 850mb winds rms 3h forecast valid at 0 UTC (7 day avg)
- tamdar_dev2 850mb winds rms 3h forecast valid at 0 UTC (7 day avg)
- tamdar_dev2 850mb winds rms 3h forecast valid at 0 UTC
- tamdar_dev 850mb winds rms 3h forecast valid at 0 UTC

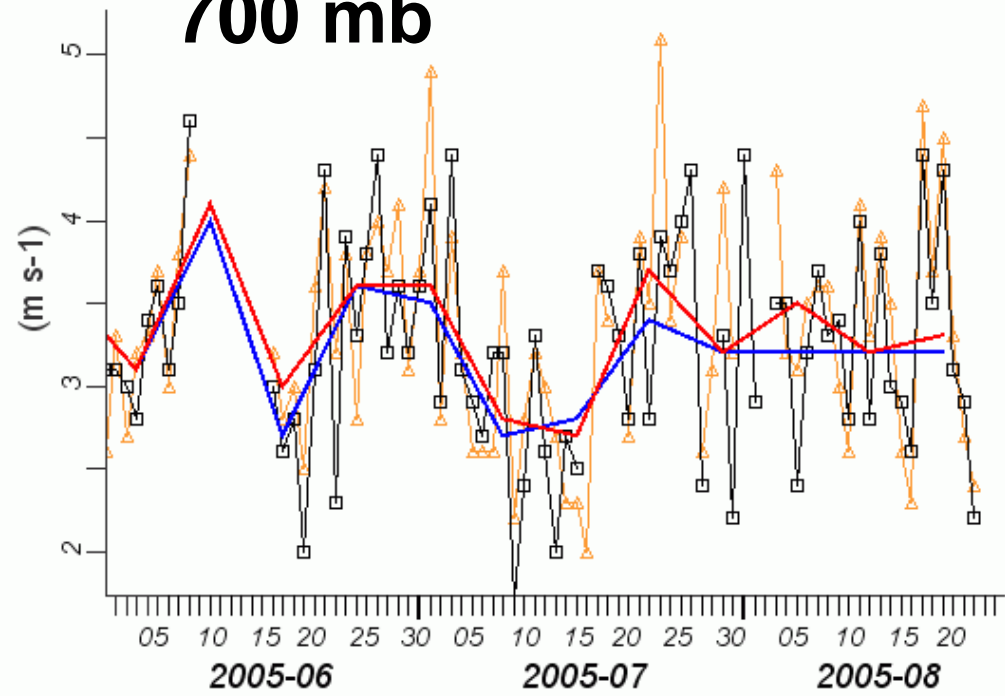
Winds show
some
improvement in
Phases 3 - 4

850 mb



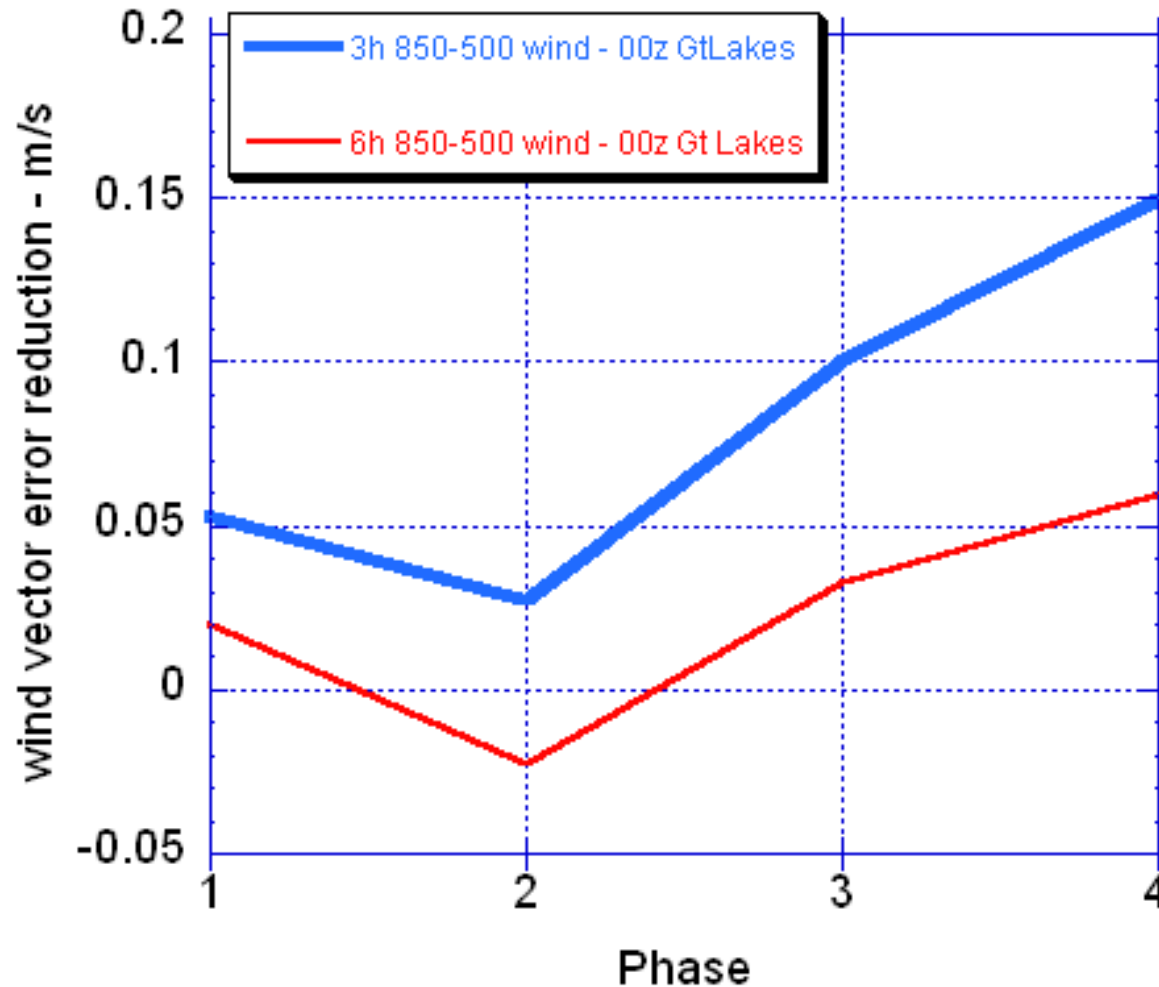
- tamdar_dev 700mb winds rms 3h forecast valid at 0 UTC (7 day avg)
- tamdar_dev2 700mb winds rms 3h forecast valid at 0 UTC (7 day avg)
- tamdar_dev2 700mb winds rms 3h forecast valid at 0 UTC
- tamdar_dev 700mb winds rms 3h forecast valid at 0 UTC

700 mb



Phase 3-4 – Jun-Aug 05

WIND – averaged over 850-500 mb



-- Now: 10%
Reduction of
3h Wind
fcst err

FSL-RUC TAMDAR impact experiment results as of September 2005

- **Results (TAMDAR impact) have improved during continued TAMDAR shakedown phase**
- **Temperature impact:**
 - strongest at 850 mb
 - ~15-20% reduction of 3h forecast error
 - Less positive impact at 700-500 mb
- **RH Impact:**
 - Positive at 850 mb
 - ~12% reduction of 3h forecast error
 - Negative impact at 700-500 mb
- **Higher vertical resolution yields**
 - better Temperature and RH impact

FSL-RUC TAMDAR impact experiment results as of September 2005 (continued)

- **Wind impact:**
 - Variable in 850-700-500mb layers
 - average ~10% reduction of 3h forecast error
- **Diurnal variations:**
 - more 3h impact at 00z than 12z
- **Results should improve more with:**
 - Further improvements in TAMDAR data accuracy
 - Implementation of more flexible reject lists
 - More restrictive quality control
 - Better treatment of RH assimilation (RUC13 version)